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ABSTRACT

This paper traces the development of cooperative learning strategies in the practices of two middle school mathematics teachers who implemented an innovative mathematics curriculum with their 7th and 8th grade students. The evidence suggests that these teachers increased their use of cooperative learning strategies, and this increase was related to the nature of the curriculum materials, as well as to their views of the nature of mathematics and its teaching and learning. Moreover, both teachers appeared to share a similar view of the social context of the classroom. Contains 18 references. (Author)

Cooperative Learning in Response to an Innovative Curriculum as a Manifestation of Change in Teaching Practice

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COOPERATIVE LEARNING IN RESPONSE TO AN INNOVATIVE CURRICULUM AS A MANIFESTATION OF CHANGE IN TEACHING PRACTICE

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This paper traces the development of cooperative learning strategies in the practices of two middle school mathematics teachers who implemented an innovative mathematics curriculum with their 7th and 8th grade students. The evidence suggests that these teachers increased their use of cooperative learning strategies, and this increase was related to the nature of the curriculum materials, as well as to their views of the nature of mathematics and its teaching and learning. Moreover, both teachers appear to share a similar view of the social context of the classroom.

A critical problem facing mathematics education reform is the translation of a vision of mathematics teaching and learning contained in the National Council of Teachers of Mathematics (NCTM) *Standards* documents (NCTM, 1989, 1991) into actual practice in classrooms. This vision suggests learning environments that require substantive changes in current norms of teaching practice (Brown & Borko, 1992; Schifter & Fosnot, 1992; Simon, 1994; Simon & Schifter, 1993; Thompson, 1992). Among questions associated with the current reform, Nelson (1993) asks about the role of innovative curricula. Speaking at the Research Presession of the 73rd Annual Meeting of NCTM in Boston, Susan Jo Russell, in what she terms a hopeful observation, suggests two ways in which curriculum materials can be powerful tools for reform:

- Innovative curricula allow teachers to focus on the particularity of their own classrooms, and
- Innovative curricula support teachers' efforts to establish mathematical communities (Lindquist, et al, 1995).

This research report will trace the development of cooperative learning strategies in the practices of two middle school mathematics teachers who implemented an innovative mathematics curriculum.

Methodology

In the fall of 1992, a large, urban school district in the northeast began a district-wide implementation of an innovative mathematics curriculum in grades 8-10. The materials implemented were the University of Chicago School Mathematics Project (UCSMP) *Transition Mathematics* (grade 8), *Algebra* (grade 9), and *Geometry* (grade 10). Teachers involved in the UCSMP implementation received some staff development This took the form of a series of eight Saturday morning paid inservice meetings spaced at 4 or 5 week intervals. The content of these inservice meetings typically involved teachers presenting their reactions to the UCSMP materials, as well as training in instructional strategies supportive of the UCSMP materials. Cooperative learning strategies were among those in which such training was provided.

In the fall of 1992, a case study of an eighth-grade teacher who was implementing the UCSMP *Transition Mathematics* materials for the first time was begun. This case study was developed over the course of two school years, and in the fall of 1993, a second case study was opened. The second teacher was part of a pilot project testing the efficacy of teaching the UCSMP *Transition Mathematics* and *Algebra* courses over three years: grades 7, 8, and 9. She was also using the UCSMP materials for the first time and implemented about 60% of the *Transition Mathematics* materials in her seventh-grade classes.

These two case studies were developed using qualitative data. The data were triangulated across time and across three primary sources:

- Fieldnotes taken from observations of the teachers using the UCSMP materials.
- Interviews of the teachers.
- Reflective journals kept by the teachers.

Diane, the subject of the two-year case study, was observed 13 times while Gina, who was studied for a single year, was observed 8 times. The observations were spaced at approximately 4-5 week intervals. Each teacher was also interviewed on the day of the observations. The interviews were semi-structured using an interview guide (Patton, 1990) and were typically 45 minutes to an hour in duration. Both teachers also kept journals of their reflections regarding the UCSMP implementation. These journals were interactive with the researcher.

The data were analyzed using a constant comparative approach (Glazer and Strauss, 1967). Of particular interest was the question of what instructional changes, if any, these teachers would make in response to their implementation of the UCSMP materials. An attempt was made to ground results in the ongoing interpretations of the researcher (Strauss, 1987). The data were coded and sorted in a manner suggested by Jorgensen (1989). Conceptual categories were derived from the research questions, and themes that emerged from the data themselves provided keywords. Matrix arrays of the data were also produced to aid in understanding relationships. As theories emerged from the analysis, they were tested against the data and further refined.

Findings

As the studies unfolded and patterns began to emerge from the data, it became apparent that Diane and Gina were changing their instructional practices in quite similar ways. One of the most striking of these changes was the increased use, albeit for somewhat different reasons, of cooperative learning strategies by both of them.

The Case of Diane

Diane teaches 7th- and 8th-grade mathematics in a K-8 school and is the only teacher certified in secondary mathematics in that building. She was selected for

the study in part because her responses to a survey questionnaire were fairly representative of a large group of teachers who would be using the UCSMP materials for the first time.

At the close of the school year prior to her first year of UCSMP implementation, in completing the survey questionnaire, Diane had indicated disagreement with the statement: Students working in cooperative groups can learn just as well as from whole class instruction. During our first interview at the beginning of the next school year, I asked Diane to elaborate her response:

> I guess in my experience, with these students, at least, I haven't come up with a way yet to get them to work in small groups that's productive.

When I probed further, Diane indicated that she would find cooperative learning groups acceptable, if she could be shown ways to bring such strategies to fruition in her classroom.

This interaction apparently kindled, or perhaps rekindled, Diane's interest in cooperative learning strategies, for in a November journal entry, she wrote:

> I've been reading some books on cooperative learning teams, and I've signed up for a cooperative learning inservice. I plan to really work at using these strategies in my classroom.

Diane also attended the cooperative learning workshop that was part of the series of UCSMP inservices mentioned earlier. Moreover, her regular use of the Teacher's Edition of the UCSMP textbook brought her into almost daily contact with subtle hints and suggestions that are provided in the Teaching Notes that accompany each lesson in the text. These notes cover a variety of topics, including small group work.

The fieldnotes of my observations of Diane's practice confirm that she attempted to use cooperative learning strategies, with some success, through the end of the second year of the study. During an interview near the end of the first year, I asked Diane if working with the UCSMP materials had influenced her instructional practice in any ways.

> I think that through the UCSMP, I started to use cooperative learning more. And that was one thing that I had wanted to do.

The Case of Gina

Gina teaches 7th-grade mathematics in a K-8 school that has a large proportion of students for whom English is a second language (ESL). She was selected for the study due to the possible tension between the large number of ESL students in her classes and the reading requirements of the UCSMP materials.

During our first interview, prior to her use of the UCSMP materials, I asked with what importance she viewed cooperative learning strategies:

> In the past I haven't used it, definitely not most of the time, and probably not half of the time. I don't think I'm going to have much choice with this program. I'm just going to have to have them work in groups, just to get as much experience as possible ... because of the pace of the course; because of the whole setup of everything.

In this instance, I interpreted Gina's remarks to indicate that she viewed the UCSMP materials, with their heavy reliance on student reading, as problematic due to the large number of ESL students in her classes. She then decided to use cooperative learning groups, which provide a format for students to use each other as resources, as a response to this problematic situation.

Indeed, the fieldnotes of my observations of Gina's work confirm her use of such learning contexts. Her use of cooperative strategies was often limited to pairs and triads, but for activities such as Think-Pair-Share (Davidson, 1990) and semantic mapping (Carrell, Pharis, & Liberto, 1989), larger groups were utilized.

Toward the end of the school year, I asked Gina to tell me about any changes in instructional practice that she might have made that were related to her use of UCSMP materials. Without hesitation, at the top of her list was, *I've used more group work.*

Teacher Beliefs

Thompson (1992) acknowledges the relationship between teachers' beliefs about the nature of mathematics and their instructional practices that is suggested by a number of studies. Ernest (1989) proposes three main categories of views of mathematics, which he characterizes as Platonist, instrumentalist, and problem solving. Ernest also notes that mathematics curriculum reform efforts are often based on mathematics perspectives and links the current reform efforts with the problem solving view.

Diane and Gina both selected the problem solving description of mathematics from among Ernest's three views as most closely describing their own view of mathematics. When asked to generate adjectives or adverbs to describe mathematics, both offered "broad;" Gina suggested "art" and "science;" while Diane chose "logical" and "invented." Moreover, in choosing words to describe the processes of learning and teaching mathematics, Gina offered "collaborative," "fun," and "interesting," and Diane "inexact," "challenging," and "never-ending." These selections seem to fit well with both Ernest's problem solving view of mathematics and the underlying philosophy of UCSMP, which embraces the NCTM *Standards* (UCSMP, 1992).

Discussion

Both Diane and Gina attribute their increased use of cooperative learning strategies to their use of the UCSMP textbook. It seems no accident that their espoused views of mathematics are a good fit with those of the NCTM *Standards* authors. In addition, these teachers were observed to make changes in instructional prac-

tice that suggest a transition in their conception of the role of the teacher away from one as a "transmitter of knowledge" and toward one as a "facilitator of learning." An increased use of cooperative learning strategies was one embodiment of that transition.

The observation that the teachers' use of the innovative UCSMP materials fostered changes in teaching practice may be interpreted in a manner that is consistent with constructivist thinking. These teachers' daily interactions with the innovative textbook and materials, their students, and their students' reactions to the materials required them to interpret the innovation on a regular basis. This may well have provided a source of continuing perturbation in their understanding of their own practices, and the resolution of any such perturbation may well have resulted in changes in instructional practice.

These results also seem to fit well with several points in Ernest's (1991) analysis of the influence of social context on teaching practice. Among the factors that Ernest includes in the social context are the textbook and the curriculum. If there is indeed a good fit between these teachers' belief structures and the epistemology that underpins the work of UCSMP, it is likely that the use of these materials acted as a powerful catalyst for change in these two teachers' instructional practices.

In his analysis, Ernest (1991) notes that "the socialization effect of the context is sufficiently powerful that despite having differing beliefs about mathematics and its teaching, teachers in the same school are observed to adopt similar classroom practices" (p. 289). However, it is likely that such a constraint did not arise in the case of Diane, because she is the only secondary mathematics teacher in her school, nor in the case of Gina, who has little day-to-day professional contact with the only other secondary mathematics teacher in her school. Moreover, if my interpretation is accurate, both Diane and Gina were changing their conception of their role as teacher, and the nature of that transition toward more of a facilitator's role suggests that they viewed the social context within their own classrooms as more of an opportunity than a constraint to change.

Conclusion

The research herein reported suggests that innovative textbooks and curriculum materials might serve as catalysts for change in instructional practice, even when implemented with minimal support. The teachers in this study appear to embody both of Russell's observations previously noted. In focusing on the particularity of their own classrooms, they seemed to view the development of mathematical learning communities as an advantageous change, while the innovative curriculum materials that they were using supported their efforts to establish such communities.

One extension of this research is to ask the question, "What if an innovative textbook or curriculum is implemented together with a high level of support for teachers' attempts to bring their practices in line with the innovations?" Developers provide some support for innovative materials which are currently available. The role in the process of change of both the innovative materials and the adjoined support efforts, as well as their interaction, deserves our attention.

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